A.6 Western Burrowing Owl (*Athene cunicularia*)

A.6.1 Legal Status

The western burrowing owl (*Athene cunicularia*) is designated as a state Bird Species of Special Concern (Shuford and Gardali 2008) by the California Department of Fish and Game (DFG). Nest sites are protected in California under Fish and Game Code Sections 3503.5, 3505, and 3800.

The burrowing owl has no federal regulatory status; however, the species is protected under the federal Migratory Bird Treaty Act and is designated as a Bird of Conservation Concern by the U.S. Fish and Wildlife Service (USFWS 2002).

A.6.2 Species Distribution and Status

Range and Status

There are two subspecies of burrowing owls in North America (Dechant et al. 2003). The breeding range of *A. cunicularia floridana* is restricted to Florida and adjacent islands. The breeding range of *Athene cunicularia hypugaea* extends south from southern Canada throughout most of the western half of the United States and south to central Mexico. The winter range is similar to the breeding range except that most owls from the northern areas of the Great Plains and Great Basin migrate south and southern populations are resident year round (Haug et al. 1993).

Burrowing owls were once widespread and generally common over western North America, in treeless, well-drained grasslands, steppes, deserts, prairies, and agricultural lands (Haug et al. 1993). The owl's range has contracted in recent decades, and populations have been generally diminished in some areas.

In California, burrowing owls are widely distributed in suitable habitat throughout the lowland portions of the state (Figure A.6.1); however, occupied sites have ranged from 200 feet below sea level at Death Valley, to above 12,000 feet at Dana Plateau in Yosemite (DFG 2000). In southern California, the species is fairly common along the Colorado River Valley (Rosenberg et al. 1991) and in the agricultural region of the Imperial Valley. Only small, scattered populations are thought to occur in the Great Basin and the desert regions of southern California (DeSante et al. 1997). Burrowing owl breeding populations have greatly declined along the California coast, including the southern coast to Los Angeles, where these owls have been eliminated from virtually all private land, and occur only in small populations on some federal lands (Trulio 1997, Garrett and Dunn 1981). Breeding populations in Central California include the southern San Francisco Bay between Alameda and Redwood City, the interior valleys and hills in the Livermore area, and the Central Valley (DeSante et al. 1997). While the northeastern and eastern populations are migratory, the Central and Southern California populations are generally considered predominantly non-migratory (Haug et al. 1993).

Overall population trend throughout the subspecies' North American range is reportedly declining. James (1993) reports that 54 percent of the areas sampled reported declining burrowing owl populations. Breeding Bird Surveys conducted between 1980 and 1989 also report significant declines in many areas (Haug et al. 1993).

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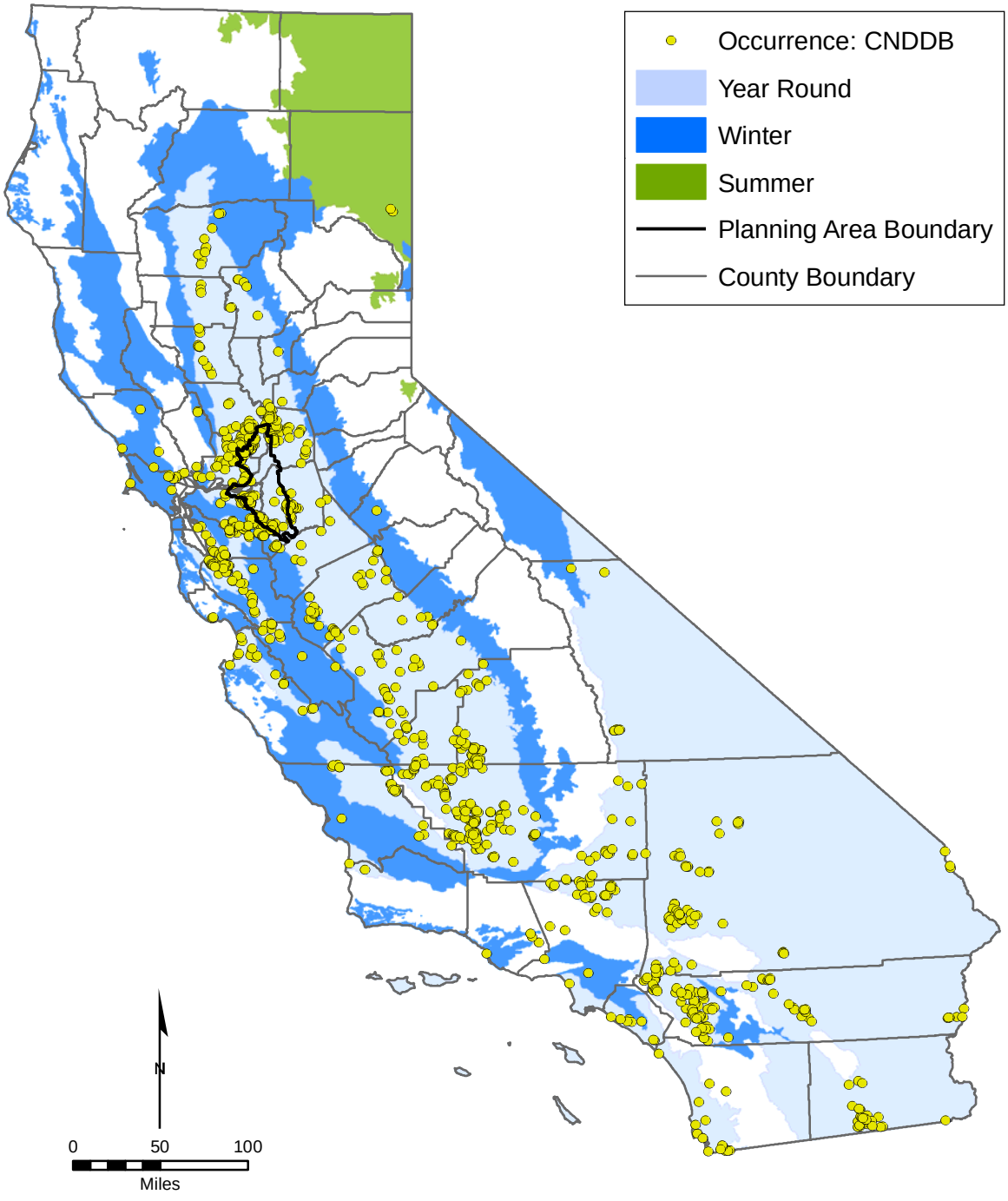

Source: California Department of Fish and Game, WHR, 2006.
California Department of Fish and Game, CNDDB, 2008.

Figure A.6.1. Western Burrowing Owl Statewide Range and Recorded Occurrences

Burrowing owl was formerly common or abundant throughout much of California, but noticeable declines have been reported since the 1940s (Grinnell and Miller 1944) and continue to the present time (DeSante and Ruhlen 1995, DeSante et al. 1997). The decline has been almost universal throughout California. Conversion of grasslands and pasturelands to incompatible crop types and the destruction of ground squirrel colonies have been the main factors causing the decline of the burrowing owl population (Zarn 1974). Assimilation of poisons applied to ground squirrel colonies also affects borrowing population levels.

Surveys in California in 1986-91 found population decreases of 23 to 52 percent in the number of breeding groups and 12 to 27 percent in the number of breeding pairs of owls (DeSante et al. 1997). Nearly 60 percent of burrowing owl colonies that existed in the 1980s reportedly disappeared by the early 1990s (DeSante and Ruhlen 1995, DeSante et al. 1997).

DeSante et al. (1997) estimated a statewide population of 9,266 breeding pairs, most occurring four main population areas, the Imperial Valley, the Central Valley, the Southern California coast, and the San Francisco Bay Area. An estimated 167 nesting pairs (1.8 percent of California's population) remain in the Bay Area, where the species is commensal with the California ground squirrel (*Spermophilus beecheyi*) and resides in undeveloped grassland remnants amid a rapidly expanding human population. In the southern California coastal population, burrowing owls have been almost entirely extirpated from private lands and are now found only on a few undeveloped federal lands, where an estimated 260 nesting pairs (3 percent of California's population) persist. An estimated 2,224 nesting pairs exist in the Central Valley (24 percent of California's population), where the species is also subject to widespread habitat loss from urbanization. The species is also commensal with the California ground squirrel and resides in remaining patches of grassland, along the grassland edges of canals and levees, and along the edges of pastures and some agricultural fields. Burrowing owls are mostly commensal with the round-tailed ground squirrel (*Spermophilus tereticaudus*) in the Imperial Valley, where burrowing owls are almost completely relegated to irrigation canal banks and where an estimated 6,570 nesting pairs (71 percent of California's population) remain (all data from DeSante et al. 1997, presented also in Barclay et al. 1998).

Although California has a significant burrowing owl population, development pressures and recent population trends suggest that the species may continue to be extirpated from large portions of its range in California during the next decade. Coastal areas, in particular, have experienced extirpations or near extirpations in recent years presumably from habitat loss. While burrowing owls in the Central Valley have exhibited strong site fidelity even with increasing habitat fragmentation, many active areas have been locally extirpated due to increasing urbanization and related causes.

Distribution and Status in the Planning Area

Within the BDCP Planning Area, burrowing owls are concentrated mostly in the pastureland areas west of the Sacramento Deep Water Ship Channel in Yolo and Solano counties, and in the grassland habitats along the western edge of the BDCP Planning Area between roughly Brentwood/Antioch and Tracy (Figure A.6.2). These mostly uncultivated areas support larger and more stable populations of California ground squirrels and are less likely to be disturbed by regular cultivation and other ground disturbances.

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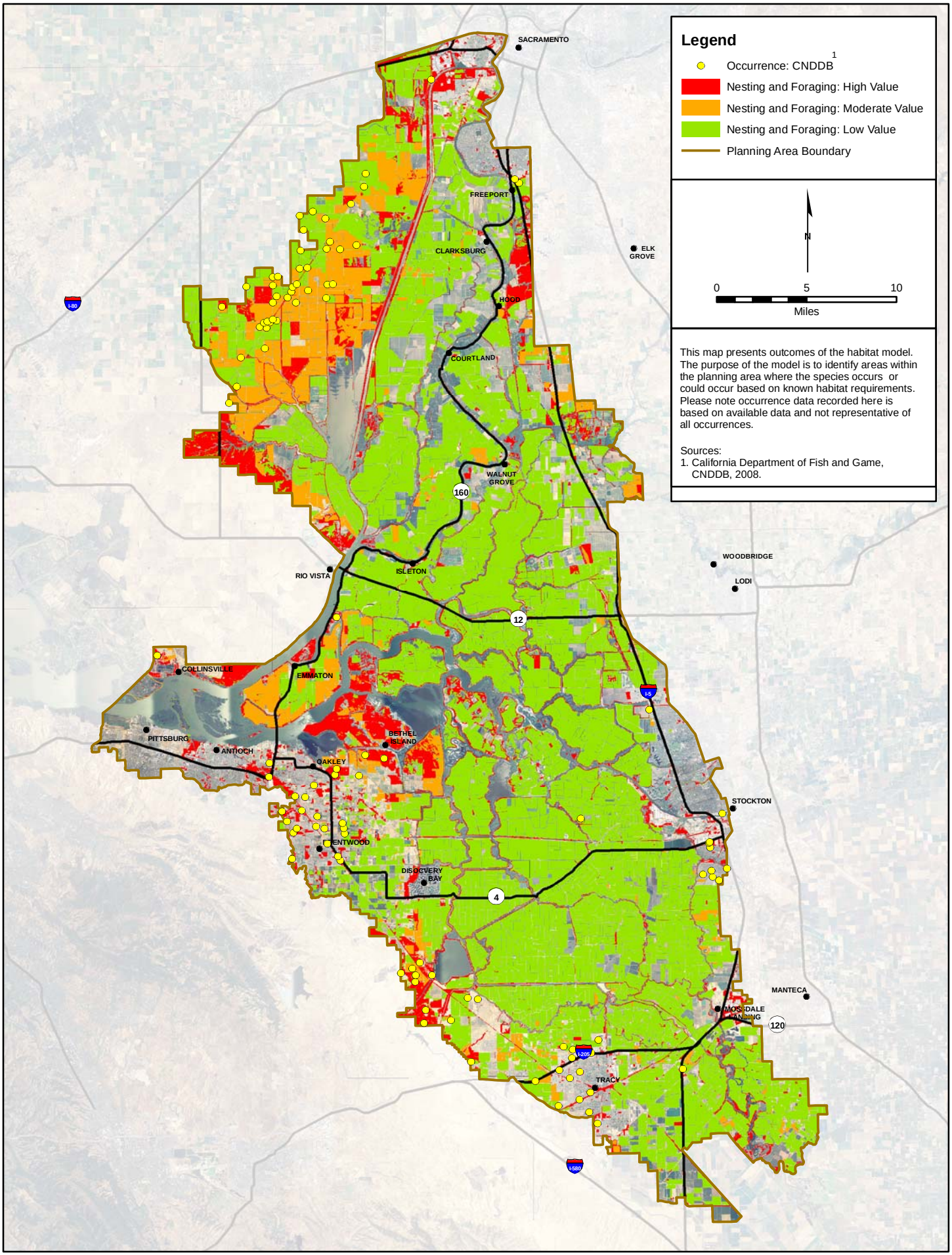

Figure A.6.2. Western Burrowing Owl Habitat Model and Recorded Occurrences

Burrowing owls continue to persist locally in the vicinity of Stockton where they are typically found along levees, canals, field edges, and some ruderal habitats or idle fields. Burrowing owls are also known to occur in the grassland habitats in the vicinity of Stone Lakes. While relatively few burrowing owls occur in this area, the grassland habitats could potentially support a larger population. In recognition of this, enhancement of burrowing owl habitat, including the installation of 80 artificial nest boxes, reintroduction of the California ground squirrel, and adjustment of land management activities, is ongoing on the Stone Lakes National Wildlife Refuge. These activities are part of an agreement with the Sacramento Area Flood Control Agency and Sacramento County to use the refuge for purposes of burrowing owl mitigation because of impacts from the South Sacramento Streams Group Project (SAFCA, Resolution Number 07058).

Few burrowing owls occur in the central portion of the Delta and the northern Delta east of the Sacramento Deep Water Ship Channel (Figure A.6.2) due mainly to regular cultivation, lack of undisturbed habitats, and lack of ground squirrel populations. Active sites in this area are generally restricted to levee embankments and along irrigation canals.

Remaining populations in the vicinity of Stockton, Brentwood/Antioch, and Tracy are subject to continued land use changes from urbanization and populations are likely to decline over time as suitable habitat is removed. Populations in Yolo and Solano Counties west of the Deep Water Ship Channel are less subject to land use changes and thus are more likely to persist.

A.6.3 Habitat Requirements and Special Conditions

Burrowing owls are found in open, dry grasslands, agricultural and range lands, and desert habitats often associated with burrowing animals (Klute et al. 2003). They also occupy golf courses, airports, road and levee embankments, and other disturbed sites where there is sufficient friable soil for burrows (Haug et al. 1993). Because they typically use the burrows created by other species, particularly the California ground squirrel, presence of these species is usually a key indicator of potential occurrence of burrowing owl.

Nesting. In northern California, most nest sites occur in abandoned ground squirrel burrows; however, other mammal burrows and various artificial sites, such as culverts, pipes, rock piles, and artificially-constructed burrows are also used. Burrowing owls generally select sites in relatively sandy habitats that allow for modification of burrows and maximize drainage. In addition to providing nesting, roosting, and escape burrows, ground squirrels improve habitats for burrowing owls in other ways. Burrowing owls favor areas with short, sparse vegetation (Coulombe 1971, Haug and Oliphant 1990, Plumpton and Lutz 1993b) to facilitate viewing and hunting, which is typical around active sciurid colonies. Additionally, burrowing owls may select areas with a high density of burrows (Plumpton and Lutz 1993b). Typical habitats are treeless, with minimal shrub cover and woody plant encroachment, and have low vertical density of vegetation and low foliage height diversity (Plumpton and Lutz 1993b). While occupied burrows are sometimes found in flat landscapes – often in elevated mounds created by burrowing activity, they are also commonly found on hillsides, levee slopes, or other vertical cuts, probably to facilitate drainage and maximize visibility. Nest sites are also often associated with nearby perches, including stand pipes, fences, or other low structures.

Optimal nesting locations are within an open landscape with level to gently sloping topography, sparse or low grassland or pasture cover, and a high density of burrows.

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Burrowing owls are tolerant of human-altered open spaces, such as areas surrounding airports, golf courses, and military lands where burrows are readily adopted (Thomsen 1971). Burrowing owls may select areas adjacent to unimproved and improved roads (Brenckle 1936, Ratcliff 1986); a modest volume of vehicle traffic does not appear to significantly affect behaviors or reproductive success (Plumpton and Lutz 1993c). In the South San Francisco Bay region and in the Sacramento area, burrowing owls nest and winter in highly human-affected environments and can adjust to most types of human activity if habitats remain in a suitable condition.

The dimensions of the nest burrow vary with location, age of burrow, and the species that originally excavated it. Typical burrows constructed by ground squirrels are from 3 to 6 inches in diameter and extend underground at a gradual downward slope from 3 to 10 feet with an enlarged cavity at the end of the burrow. Burrow entrances are often adorned with various objects as well as feathers and pellets. The burrow is often lined with grass or other material (Haug et al. 1993).

Burrowing owls are solitary nesters or may nest in loose colonies – usually from 4 to 10 pairs (Zarn 1974); however, larger colonies have been documented. Most pairs occupy a natal burrow and at least one additional satellite burrow.

As semi-colonial raptors, colony size is indicative of habitat quality. Colony size is also positively correlated with annual site reuse by breeding burrowing owls; larger colonies (those with more than five nesting pairs) are more likely to persist over time, than colonies containing fewer pairs or single nesting pairs (DeSante et al. 1997). Nest burrow reuse by burrowing owls has been well documented (Martin 1973, Gleason 1978, Rich 1984, Plumpton and Lutz 1993b, Lutz and Plumpton 1999). Former nest sites may be more important to continued reproductive success than are mates from previous nest attempts (Plumpton and Lutz 1994). Past reproductive success may influence future site re-occupancy by burrowing owls. Female burrowing owls with large broods tend to return to previously occupied nest sites; while females that fail to breed or produced small broods, may change nest territories in subsequent years (Lutz and Plumpton 1999).

In general, burrowing owls show a high degree of nest site fidelity and reuse the same nesting burrows and satellite burrows for many years if left undisturbed.

Foraging. Burrowing owls forage in open grasslands, pasturelands, agricultural fields and field edges, fallow fields, along the edges of roads and levees. Vegetation is low to maximize visibility and access. Short perches, such as fence posts are often used to enhance visibility. While they will defend the immediate vicinity of the nest, burrowing owls will often forage in common areas (Haug et al. 1993).

A.6.4 Life History

Description. This small owl stands about 9 inches tall. The sexes are similar (although females are slightly larger and often slightly darker than males) with distinct oval facial ruff, white eyebrows, yellow eyes, and long stilt-like legs. Wings are relatively long (20 to 24 inches) and somewhat rounded. The owl is sandy colored with pale white spots on the head, back, and upperparts of the wings and white-to-cream with barring on the breast and belly (Haug et al. 1993).

Seasonal Patterns. Burrowing owls are resident in northern California. The breeding season (defined as from pair bonding to fledging) generally occurs from February to August with peak activity occurring from April through July (Haug et al. 1993). Pairs may be resident at breeding

sites throughout the year or migrate out of the breeding area during the non-nesting season. Some individual birds only winter in the region. Thus, the demographics of this species in the region are relatively dynamic. Burrowing owls have a strong affinity for previously occupied nesting and wintering habitats. They often return to burrows used in previous years, especially if they had been reproductively successful (Lutz and Plumpton 1999). Additionally, burrowing owls often return as breeding adults to the general area in which they were born. For these reasons, efforts that enhance productivity help to ensure continued use of burrows and territories.

Migration patterns vary among burrowing owls. As noted above, in northern California burrowing owls are generally year-round residents although some may migrate from or migrate to other regions during winter. Those burrowing owls that do migrate often return to the same nesting territories in successive years.

Reproduction. Adults begin pair bonding and courtship in February through March. Following pair formation, a nest is established in the natal burrow and females lay a clutch of 6 to 11 eggs. Average clutch size is 7 to 9 eggs. Eggs are incubated entirely by female for a period of between 28 and 30 days. During this time, the female is provisioned with food by the male. Following hatching, the young remain in the natal burrow for 2 to 4 weeks after which they begin to emerge from the burrow and roost at the burrow entrance. The female begins hunting as young become less dependent. Adults also often relocate chicks to satellite burrows presumably to reduce the risk of predation (Desmond and Savidge 1998) and possibly to avoid nest parasites (Dechant et al. 2003). After approximately 44 days, young leave the natal burrow and by 49 to 56 days begin to hunt live insects. On average, three to five young fledge, but fledging rates can range from a single chick to as many as eight or nine (Lutz and Plumpton 1999). During this time, the juveniles expand their range and may find cover in the satellite burrow. The juveniles continue to be provisioned by the adults until mid-September when they molt into adult plumage and begin to disperse (Landry 1979). King and Belthoff (2001) report that dispersing young use satellite burrows in the vicinity of their natal burrows for about two months after hatching before departing the natal area.

Home Range/Territory Size. Few valid measures of territory or home range size of burrowing owls have been published; home range has not often been measured directly (e.g., via telemetry studies), and is highly subject to observer bias or equipment effect. Accordingly, caution is warranted when interpreting home range estimates. Gervais et al. (unpublished 2000 report in: Yolo Natural Heritage Program 2008) estimated that the mean minimum convex polygon (MCP) home range estimates for 22 burrowing owls in Fresno and Kings Counties, California was 467 acres. Haug and Oliphant (1990) estimated that the mean MCP for six owls in Saskatchewan was 595 acres. (Yolo Natural Heritage Program 2008)

In Colorado, Plumpton and Lutz (D. Plumpton pers. comm. in Yolo Natural Heritage Program 2008) recorded densities of nesting burrowing owls that ranged from 21 to 34 pairs on roughly 2,240 acres of available habitat (i.e., 106 and 65 acres/pair, respectively). Thomsen (1971) estimated territory size based on nearest-neighbor distances between nest burrows, producing a result of six pairs of owls averaging 2 acres, with a range of between 0.1 to 4.0 acres. The preceding values demonstrate the disparity among studies, the different values attained when using different methods of estimating abundance, and the risk in relying on the results of a single study. (Yolo Natural Heritage Program 2008)

Foraging Behavior and Diet. Burrowing owls are active day and night and will hunt throughout the 24-hour day, but are mainly crepuscular, hunting mostly at dusk and dawn, and

are less active in the peak of the day. They tend to hunt insects in daylight and small mammals at night. They usually hunt by walking, running, hopping along the ground, flying from a perch, hovering, and fly-catching in mid air.

Burrowing owls tend to be opportunistic feeders. Large arthropods, mainly beetles and grasshoppers, comprise a large portion of their diet. In addition, small mammals, especially mice and voles (*Microtus, Peromyscus*, and *Mus* spp.) are also important food items. Other prey animals include reptiles and amphibians, young cottontail rabbits, bats, and birds, such as sparrows and horned larks. Consumption of insects increases during the breeding season (Zarn 1974, Tyler 1983, Thompson and Anderson 1988, John and Romanow 1993, Green et al. 1993, Plumpton and Lutz 1993a). Productivity may increase in proportion to the amount of mice and voles in the diet (D. Plumpton, unpublished data in Yolo Natural Heritage Program 2008).

As with most raptors, burrowing owls select foraging areas based on prey availability as well as prey abundance. Prey availability (the ability of a raptor to detect prey) decreases with increasing vegetative cover and thus foraging habitat suitability decreases with increasing grass height or vegetative density.

A.6.5 Threats and Stressors

Urbanization/Fragmentation. Urbanization, including residential and commercial development and infrastructure development (roads and oil, water, gas, and electrical conveyance facilities) is one of the principal causes of habitat loss for burrowing owls and is a continuing threat to remaining northern California populations. Urbanization permanently removes habitat and has led to permanent abandonment of many burrowing owl colonies in the developing portions of the Central Valley, Bay Area, and throughout the state.

Interestingly, while urbanization is considered a key cause for population declines, burrowing owls are known to exhibit strong site fidelity. They have shown a relatively high level of tolerance for human encroachment, degradation of native habitats, and fragmentation of habitats (Schultz 1993, Trulio 1997). Active breeding colonies have been reported in small parcels or narrow strips of disturbed habitat along levees or utility corridors and surrounded by urban development. Colonies have also been reported along the edges of airport runways, around the perimeter fences of prisons, and in other urbanized or highly disturbed habitats (Thomsen 1971). Disturbances may depress reproductive potential in urban settings as compared with more natural habitats (Thomsen 1971). However, owls will often continue to occupy traditional sites as long as essential habitat elements remain present, until the disturbances force the owls out, or until the extent of available habitat is reduced below habitat requirements (Millsap and Bear 1988).

Agricultural Crop Conversion. Some burrowing owls nest on the edges of agricultural areas and forage in suitable agricultural fields, such as recently harvested fields, alfalfa and other hay fields, irrigated pastures, and fallow fields. The conversion of these fields to incompatible crop types, such as orchards, vineyards, and other crops that are not conducive to burrowing owl foraging, reduce available foraging habitat and lead to abandonment of traditional nesting areas.

Levee Maintenance. Many burrowing owl nests are known to occur along the outside slope or at the toe of levees. Levee stability practices for flood control, including vegetation removal, grading, and reinforcing with rock can destroy burrowing owl nesting habitat.

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Rodent Control. Rodent control, particularly along levees and roadsides can decimate ground squirrel populations and ultimately reduce available nesting and cover habitat for burrowing owls.

Other Human Disturbances. Although burrowing owls are relatively tolerant of lower levels of human activity, human-related impacts such as shooting and burrow destruction adversely affect this species (Zarn 1974, Haug et al. 1993). Artificially enhanced populations of native predators (e.g., gray foxes, coyotes) and introduced predators (e.g., red foxes, cats, dogs) near burrowing owl colonies can also be a significant local problem. Burrowing owls also get tangled in loose fences, abandoned wire, fishing line, rat traps, and other materials.

The overall effect of population-level threats (e.g., habitat conversion or ground squirrel eradication) is of much greater concern than sources of individual mortality (e.g., shooting or vehicle collisions), as these former forces operate at a population, regional, and/or range-wide level. As obligate burrow nesters that do not excavate their own burrows, burrowing owls are largely dependent on burrowing mammals that have no legal status or protection, and are commonly and purposefully eradicated by humans. Whereas, individual mortality cumulatively represents a significant number of individuals, a population that is secure and productive can offset these losses. Conversely, populations that are failing because of population-level effects cannot be sustained even in absence of direct sources of individual mortality. In California, significant economic development pressures exist, and habitat conversion for human purposes continues to degrade the abundance and quality of owl nesting habitat (Barclay et al. 1998). Few provisions exist to protect habitats over time. As a result, burrowing owls appear to be declining throughout most of California.

A.6.6 Relevant Conservation Efforts

Few conservation efforts have been undertaken to conserve burrowing owl populations. The lack of state or federal listing, and the rejection of recent efforts to list the species at the state and federal levels, limits the extent of regulatory influence. There remain several significant data gaps regarding population status and trends, migration, dispersal from nesting sites, and other aspects of annual movements.

Protection typically occurs at the local project level through implementation of the guidelines prepared by DFG (1994). While the guidelines address protection of active sites and compensation for impacts, they do not address conservation or protection at a regional level.

Regional conservation efforts have focused on the development and implementation of habitat conservation plans/natural community conservation plans. These regional conservation approaches can be an effective tool to manage and sustain burrowing owl populations if they protect sufficient suitable and occupied habitat. The majority of the BDCP Planning Area overlaps with other conservation planning efforts that are either currently being implemented (e.g., Contra Costa HCP/NCCP, San Joaquin County HCP) or are in development (e.g., Yolo County HCP/NCCP, Solano County HCP, South Sacramento County HCP). If effectively coordinated, these efforts can be an effective tool in managing burrowing owl populations in the region. However, to date there has been limited coordination between these otherwise complimentary conservation planning efforts with respect to managing covered species.

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A.6.7 Species Habitat Suitability Model

Nesting and Foraging: High value nesting and foraging habitat for the western burrowing owl (Figure A.6.2) includes the following grassland land cover types:

- California annual grasslands (California Annual Grassland/Herbaceous Alliance)
- Ruderal herbaceous grasses and forbs (*Cynodon dactlyon* Alliance and Ruderal Herbaceous [nonnative annual forbland)
- *Bromus diandrus – Bromus hordeaceus*
- Italian rye-grass (*Lolium multiflorum* Alliance)
- *Lolium multiflorum – Convolvulus arvensis*

Moderate value nesting and foraging habitat includes the following:

- Native and irrigated pasture types.
- Levee slopes in managed and natural seasonal wetlands

Low value nesting and foraging habitat includes the following:

- Interior grassy slopes of levees surrounding Central Delta Islands.
- Managed Seasonal Wetlands (when not flooded)
    - Temporarily flooded grasslands
    - Rabbitsfoot grass
    - Intermittently flooded perennial forbs
    - Managed annual wetland vegetation (non-specific grasses and forbs)
    - Shallow flooding with minimal vegetation
    - Seasonally flooded undifferentiated annual grasses and forbs
    - Managed akali wetland
    - Intermittently or temporarily flooded undifferentiated annual grasses and forbs
- Natural Seasonal Wetlands (when not flooded)
    - Saltgrass (*Distichlis spicata*)
    - *Distichlis spicata* – annual grasses
    - Seasonally flooded annual grasslands
    - Vernal Pools
    - Temporarily flooded perennial forbs
- Agriculture
    - Irrigated cropland (roadsides and levees as potential nesting sites and fields for seasonal foraging).

Assumptions: Western burrowing owls require habitat with three attributes: open, well-drained terrain; short, sparse vegetation; and underground burrows or burrow facsimiles (Klute et al. 2003). In Northern California, most nest sites occur in abandoned ground squirrel burrows; however, other mammal burrows and various artificial sites, such as culverts, pipes, and rock piles are also used (Haug et al. 1993). Optimal nesting locations are within an open landscape with level to gently sloping topography, sparse or low grassland or pasture cover, and a high density of burrows. However, nest locations also include disturbed habitats within this landscape, including roadside berms, levee slopes, and debris piles.

Western burrowing owls occur primarily in open grassland habitats where vegetation is low to maximize visibility and access. Moderate value foraging and nesting habitat includes native and irrigated pasture types that maintain a relatively constant vegetation structure and berms, road

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edges, and fence rows around the perimeter of fields; and levee slopes in managed and natural seasonal wetland types. Low value nesting and foraging habitat includes seasonal wetland types that are dry during the breeding season and types (e.g., irrigated crops) that exhibit periodic or seasonal foraging value due to management activities and changes in vegetation structure. A variety of irrigated crop types may be used; however, use is generally associated with low vegetative structure and thus occurs primarily during pre-planting or post-harvesting seasons. Because most irrigated crop types are rotated seasonally or annually, the distribution of suitable types will also vary seasonally and annually. Thus, this model overestimates the extent of these lower value agricultural foraging habitats in any given year.

A.6.8 Recovery Goals

A recovery plan has not been prepared for this species and no recovery goals have been established.

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